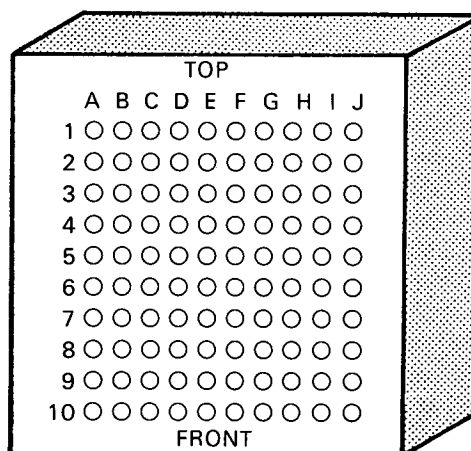


AEC-NASA TECH BRIEF



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Beam Profiles Measured with Thermoluminescent Dosimeters



The problem:

To develop a simple and straightforward method of measuring the profile and intensity of a synchrotron's external proton beam.

The solution:

A beam profilometer, employing thermoluminescent dosimeters, that gives a quantitative and qualitative representation of the focus of a 12.5-BeV external proton beam of a synchrotron. The total number of particles in the beam, particle distribution, and the shape of the beam can be determined.

How it's done:

Thermoluminescent dosimeters have been widely used for measuring personnel radiation exposures, material and equipment exposures, and environmental radiation levels. They are small, of simple construction, have a wide range of linear dose response, and are dose-rate independent to at least 1.7×10^6 rads/hr.

The thermoluminescent dosimeters consist of polyethylene capsules filled with thermoluminescent

powder (LiF-Mn), which can be excited by radiation and deexcited by heating. The thermoluminescent powder used consisted of LiF with Li^6 and Li^7 isotopes in natural abundances. These crystals have metastable energy levels to which electrons are raised during exposure to radiation. When heated, the electrons return to their ground states, emitting light. The amount of light, measured with a photomultiplier-scalar counting system, is directly proportional to the quantity of radiation to which the powder is exposed. The dosimeters are linear for radiation doses from 10 millirads to 10^5 rads.

The beam profilometer, shown in the figure, consists of a 10-by-10 matrix of dosimeters constructed by drilling holes the size of the capsules in an aluminum block. Letters denote horizontal positions, numbers, the vertical positions. Center-to-center spacing is 250 mils.

The profilometer is placed at a focus of the synchrotron's external proton beam for 100 machine pulses. The beam is kept below 10^{10} protons/pulse.

(continued overleaf)

Previous ionization-chamber studies and radiographic analyses have indicated typical intensities from 2 to 4×10^9 protons/pulse.

Doses are read on a commercial thermoluminescent dosimeter readout.

The horizontal distribution of intensity as a function of vertical position and the vertical intensity as a function of horizontal position are obtained by plotting the counts. These curves are then used to map the intensity with isorad lines and produce the beam intensity profile.

The results are in excellent agreement with results obtained by other techniques used for determining beam profiles. Using only one accelerator pulse, a beam of comparable size with intensity up to 10^{12} particles per pulse and as low as 10^6 particles per pulse may be analyzed.

Recent innovations in thermoluminescent dosimetry using solid LiF pellets would permit better spatial resolution and eliminate the need of polyethylene capsules for holding powder. Any support could be used for holding dosimeters in place of the aluminum block.

Notes:

1. This system could be used for determining beam spot sizes for any high intensity charged particle or gamma ray beam. It could be used by groups such as hospital personnel to determine the area irradiated on patients.
2. Additional information is available in "Measurement of Beam Profiles with Thermoluminescent Dosimeters," ANL-7196, April 1966, by Herbert Lucks, Robert W. Wheeler, and Stewart M.

Marcowitz, Argonne National Laboratory, Argonne, Illinois. The report is available from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151; price \$3.00 (microfiche \$0.65).

3. Inquiries concerning this innovation may be directed to:

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(ARG-10229)

Patent status:

Inquiries about obtaining rights for commercial use of this innovation may be made to:

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